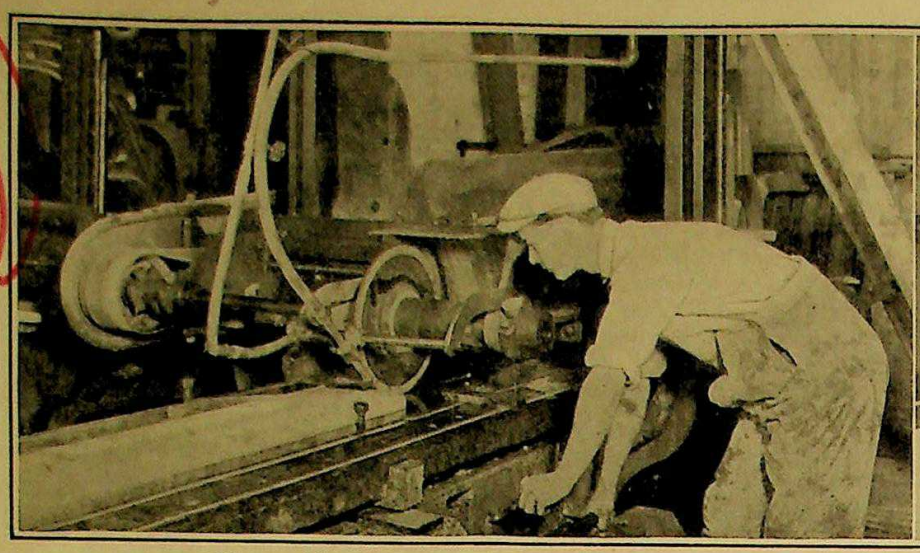
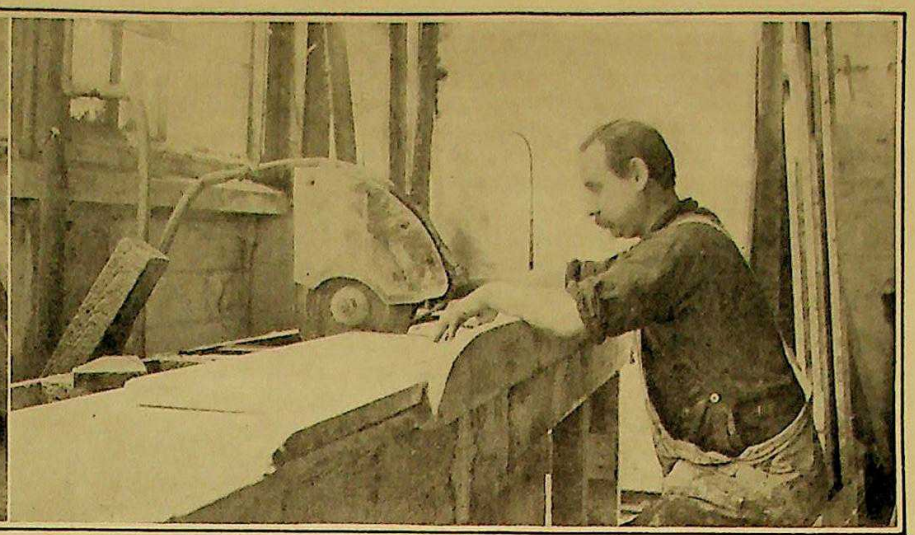


The machine that cuts out the slabs of marble



Cutting off the stock slabs with the coping wheel

Modern Marble and Granite Working

The Processes by Which the Hardest Blocks are Worked as Freely as Wood

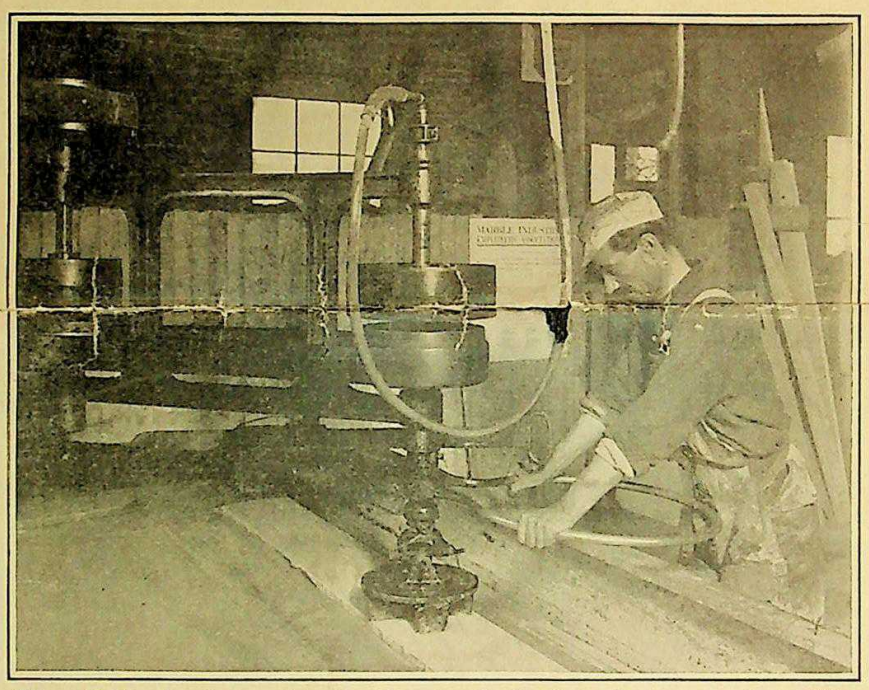
By Raymond Francis Yates

THE blackened ruins of the majestic Parthenon of Athens stand today as an enduring consecration to the artistic nature of the early masters of architecture who immortalized their ideals with such utter boldness and beauty. The noble and beautiful buildings they designed appear simple, yet their erection involved such delicate technique that they have defied duplication throughout the centuries and the lost art that brought about their creation is still as remote as the Philosopher's Stone.

Man has at his disposal many discoveries and inventions that offer him indespensable aid in stone cutting today, but the ancient Greeks had nothing but the crude chisel with which to form the various parts of their buildings. Modern stone cutting is an exact science and where it took the Greeks years to form a structure, the same work could be accomplished today in a few months by some of the large stone working companies. Modern methods of marble and granite cutting form an important chapter in industrial science, the unfolding of which should prove of interest to the layman.

As marble is a very hard and resistant substance, the task of forming and cutting it is a difficult one. Ordinary steel tools are unsuitable and in many parts of the operation it is impossible to use them. It was the advent of modern artificial abrasives, notable among them carborundum, that brought about radical changes in the marble industry, and many operations have been reduced from hours to minutes by the use of these substances with their unprecedented hardness and their unapproached sharpness and cutting power.

Marble slabs are now sawed in much the same manner as wood, and in many cases, nearly as fast. Previous to the introduction of the modern devices now used in this operation, the diamond-toothed saw found universal employment, although it had many objectionable features and shortcomings. It consisted merely of a steel disk with diamond points mounted on its periphery. The disk or "saw" was made to revolve at a high speed and the point of contact with the marble was well lubricated with water flowing under pressure. One of the recent developments in the trade, which takes the place of the diamond saw, is a steel disk equipped with carborundum teeth which are placed at regular intervals around the periphery of the disk, and which are easily detachable, being held in place by means of a wedge. When the teeth wear down they can be quickly and easily replaced at little expense. Such a saw, of course, is used only in cutting large marble or granite blocks, several feet in thickness. For cutting thin slabs of marble, a small steel disc with a continuous rim of abrasive material bonded to its periphery is used in place of the saw, and, when traveling at a speed of 7,500 surface feet per minute, this device is capable of cutting six feet of 1¼-inch marble in one minute.



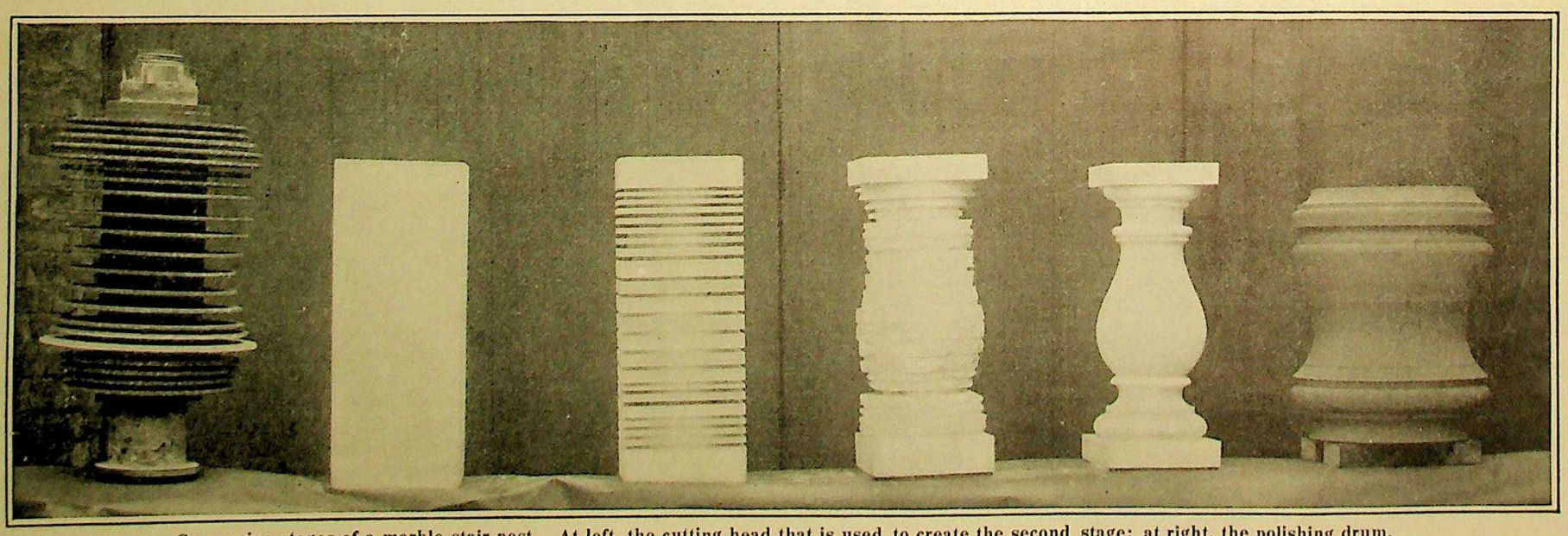
The polishing head at work. Small blocks of abrasive substance revolve rapidly upon the marble surface, bringing it to a high finish

After large marble or granite blocks have been cut by means of the saw, many irregularities or "winds" are left on the surface and these must be obliterated before the final operation of honing and polishing is applied. The approved method of removing the winds and squaring the surface after the block comes from the gang saw, is to run the piece under what is known to the trade as a "drum rubber." This consists of a cylinder of abrasive material mounted on a shaft which revolves over a horizontal traveling table to which the work is anchored. One passage under the drum is sufficient to remove all irregularities and a cut as great as ⅜-inch can be made.

In lathe work, abrasives have almost entirely replaced steel cutting tools, with a resultant saving of time and elimination of waste, as the steel tool was always a factor of uncertainty and either broke or ruined the work when a "flint" or [illegible] in the marble or granite was struck. This is not the case when using abrasives as they cut flints as easily and quickly as they do the rest of the stone and without the least possibility of destroying the work.

A good example of the lathe work accomplished today by the use of abrasives is shown in the illustration which depicts the various operations in the production of marble balusters. First, the square block is cut as shown, by putting it in a lathe and slotting it by means of a series of coping wheels, mounted on a single shaft. After this operation, the baluster is chiselled down, put into a lathe and brought to bear against a revolving carborundum drum which, in shape, is just the reverse of the baluster it is proposed to turn out. The drum used is generally made up of various shaped wheels mounted on a single shaft. By this method it is possible to produce perfect balusters of practically any design.

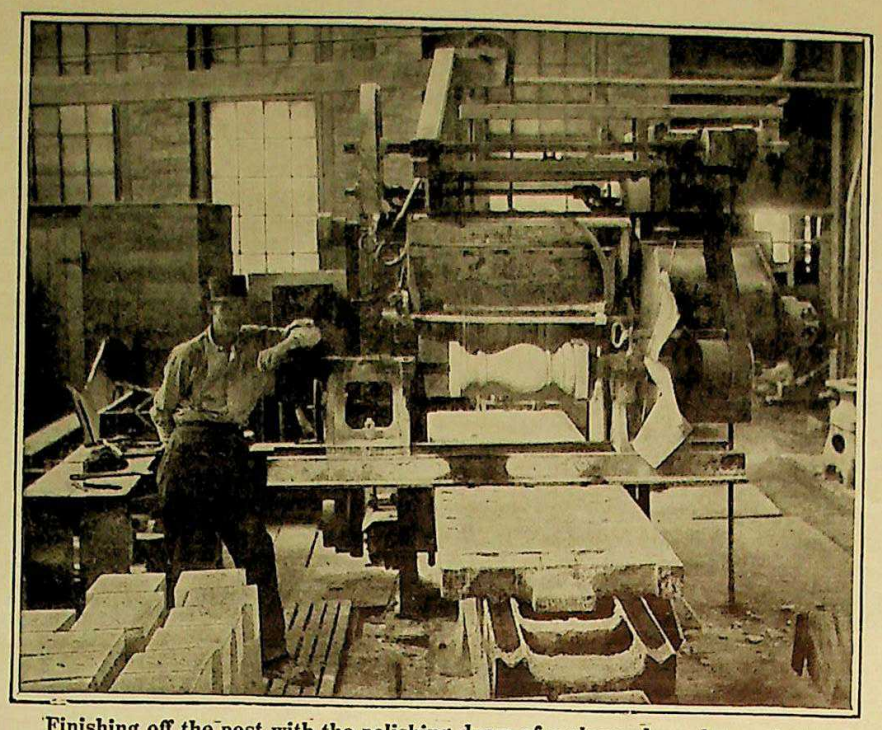
The same type of wheel that is used for producing balusters is equally adaptable to the making of moulding. By anchoring the rough stock to a table and running it under a molding wheel of abrasive material at the proper speed it is possible to produce simple designs by one cut.



Successive stages of a marble stair post. At left, the cutting head that is used to create the second stage; at right, the polishing drum, made by placing together a number of separate lifts

Of course, with the more elaborate designs it is necessary to make several cuts before the product is finished. Coarse grit wheels are capable of removing ¾-inch of stock at a single cut. By the old method of cutting marble molding it was only possible to produce very simple designs at great cost and considerable labor. By means of the present day methods, any operator can produce the most beautiful designs, with little time and expense, as far as his labor is concerned.

The process of polishing marble or granite consists of three operations technically known as roughing, second gritting, and honing. The machine used for these various operations is shown in the illustration and is known to the trade as a "grinding head." The machine causes small blocks or segments of an abrasive substance to revolve rapidly upon the stone surface to be finished. During the operation a continuous supply of water is forced through the shaft of the grinding head, which is made hollow for this purpose. The pressure of the grinding head upon the work is controlled by the operator, who can move the spindle vertically by means of a handle. The next operation, second gritting, is accomplished with the same machine, the only difference being that blocks of a finer grit are used. The final operation is also done with the same machine and blocks of a very fine grit are used which leave the surface with a beautiful polish. Thus we see that each stage of the process further finishes the operation that preceded it until a perfect surface results.



Finishing off the post with the polishing drum of carborundum shown above

Large marble columns are made in sections which are turned out on a giant lathe. The method of fluting marble columns is similar. The sections are anchored to a table which travels under two thin grinding or coping wheels driven by an electric motor at high speed. These wheels cut two slots where the proposed flute is to be. A stone cutter then chips out the material between the parallel shots and a grinding wheel is again run down the flute or channel to finish it.

Better Railroad Ties

By O. P. M. Goss, Consulting Engineer

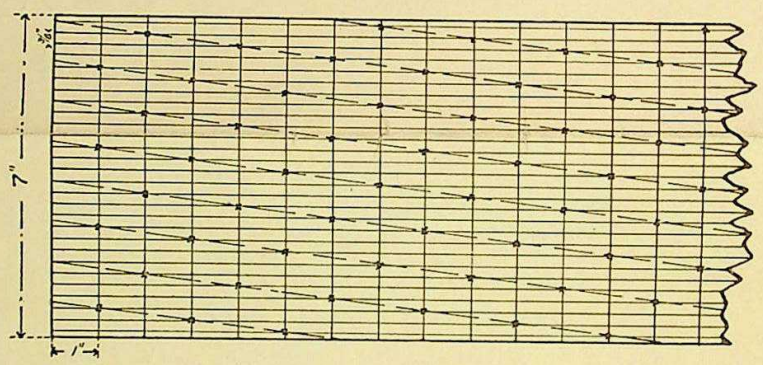
ONE of the heavy items of expense that our railroads are striving to bring to a lower level is that of tie replacement. Careful selection of the timber best suited to this use is a factor; and recently another avenue of attack has been opened by the development of the creosoting treatment, which greatly slows up the processes of decay.

This, however, is not the last word. While decay is the chief enemy of the railroad tie, it is not the only one. Heavy steam traffic produces a terrific pounding; and while the roadbed supports part of this, the tie must in the very nature of things take up much of the impact. The western roads have found that creosoted Douglas fir gives about as satisfactory a tie as is available in that territory, one with a normal life of six or seven years. But while creosoting is a necessity in order to prevent a decay whose effects would be far worse than those of the pounding, the treated ties stand up poorly under the impact stresses. The problem of tie conservation is then reduced to that of finding what feature of the treatment it is that weakens the wood, and altering that feature. This problem has been solved by an association of northwestern lumbermen.

After extensive experiments, it became evident that the loss in strength of the creosoted timbers was due mainly to the high temperatures and pressures used in the treatment. The resistance of the wood to the entry of the oil was so great that the fiber had to be broken down to a considerable degree to secure the necessary penetration. And even then the wood does not take the creosote with any approach to uniformity. So a method of introducing the oil was sought which would be at once less violent and more thorough. This sounds like a large contract; but the conditions named have been successfully met.

It is plain that oil, like anything else, will enter wood more readily along the grain than in any other direction. Of course no one would try to drive the creosote through the entire tie from the ends. But it seemed within the possibilities that the lateral surfaces might be studded with holes, of such depth and so distributed that creosote introduced into them under mild pressure would penetrate sufficiently along the grain to cover the ground between adjoining holes.

A large number of experiments were made to determine the best spacing of the holes, and the most advantageous tool for punching them. The spacing, of course, would vary with the intensity of the treatment; but since the whole purpose was to reduce that intensity, a mild treatment was outlined, and the spacing determined with reference to it. The ties were heated in creosote oil under atmospheric pressure at 170 degrees Fahrenheit for four hours. At this temprature additional pressure was then applied, rising from 0 to 100 pounds per square inch in the first hour and remaining at that figure for two hours. Finally the oil was drained off and a vacuum of about twenty-four inches drawn for half an hour.



The arrangement of punch holes finally adopted as best

When the best type of perforating had been determined, it was in order to see just how good it was. Since it was known that creosoting in the ordinary way reduced the compressive strength of the tie about forty per cent, no tests were necessary in this direction. But it was necessary to know what effect the perforating and the mild creosoting outlined had upon the strength. Accordingly each tie tested was cut into three pieces; one to be tested for compressive strength in the natural condition, one after the treatment described without perforating, and one after perforation and treatment.

The results of these tests may be summarized in the statement that the average loss of strength under treatment for 100 ties was 0.5 per cent when unperforated and 2.9 per cent when perforated. Twenty of the heavier ties were actually stronger after treatment perforated than after the plain process; and in 36 cases the creosoted tie with the holes in it developed more resistance to pressure than the original piece in natural condition. Accordingly it may be concluded that the mechanical effect of the holes in reducing the strength of the tie is negligible, and that if the treatment with perforations shows any advantages it may be safely adopted.

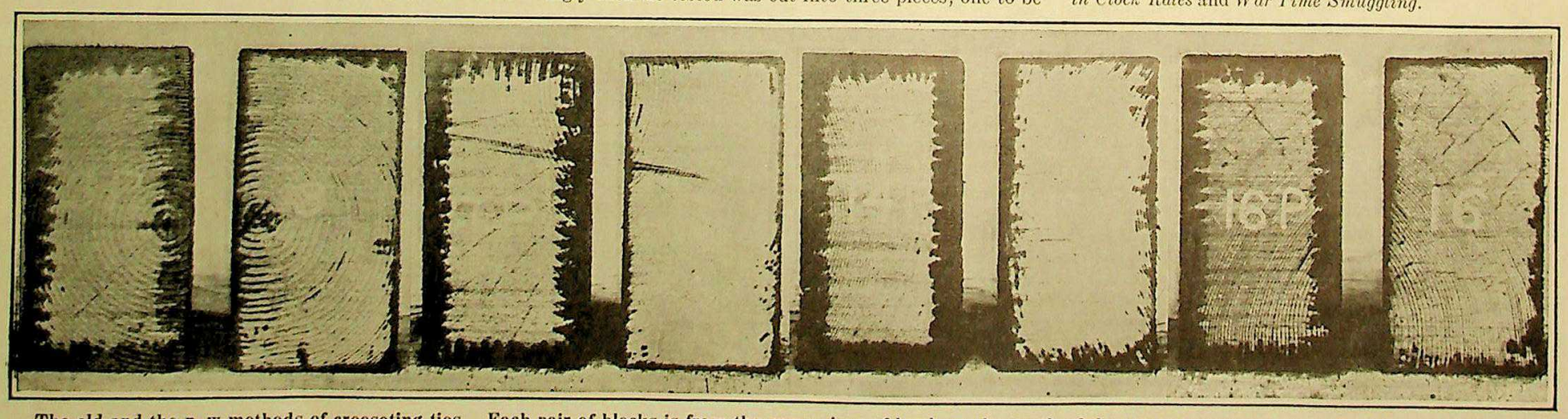
That it shows at least one advantage is evident at once; the old method cuts the resistance of the tie to pressure by 40 per cent, and this method reduces that resistance by less than three per cent. But this is not all, as our illustrations show. The old method of creosoting under high temperature and pressure, and the new mild treatment of unperforated ties, alike show the greatest lack of uniformity in their operations. But sections taken of ties creosoted after perforation by the new process show the greatest evenness of penetration; in every case the creosote appears as a broad black border of practically the same width throughout. Accordingly, the resistance to decay which is the object of the treatment is vastly more effectively obtained under the new process outlined than under the old.

The association making these investigations sums up its findings as follows:

"Cut ties in winter and early spring. Perforate, and open-pile them for air seasoning, taking advantage of the summer months. The perforations facilitate seasoning. The ties, after seasoning, may be treated as outlined above in the early fall and winter. Handling ties in this way will insure an absolute protection against decay, and will enable the wood to be creosoted without loss in mechanical strength, the two factors responsible for increased efficiency in the use of railway ties."

The Current Supplement

SUCCESSIVE discoveries of prehistoric remains have carried the time of the first evidences of the human race back to a period ages earlier than was supposed or admitted by scientists only a few years ago; but there are still many more problems that remain to be cleared up. A step in this direction will be found in the article on *Prehistoric Classification* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2189, for December 15th. *Magic Behind the Trenches* gives a faint idea of the tremendous technical problems that are being worked out in France by the Allies. The article on *Chemical Laboratory Porcelain* tells of the requirements in this class of apparatus. *Archeological Notes on the Danish West Indies* is an interesting account of an investigation of certain prehistoric rock carvings in the islands recently acquired by the United States, illustrated by a number of excellent photographs by the author. The article on *Companions of the Sun* is concluded in this number. *How the Sun, Earth and Moon Move* describes and illustrates an ingenious astronomical model constructed with a view to making the movements of these celestial bodies clear to students and others. *Permanent Magnets* deals with the effect of chemical composition, shape, dimensions, heat treatment and usage on these instruments so important in electrical constructions. Among other articles of value are *Fires in Coal Storage Piles, The Fish Louse, A Note on a Possible Explanation of Erratic Jumps in Clock Rates* and *War Time Smuggling.*



The old and the new methods of creosoting ties. Each pair of blocks is from the same piece of lumber; the result of the new process appears at the left, and of the old at the right. In every case the new method results in a deeper and a more uniform penetration of the oil

Strategic Moves of the War, December 6th, 1917

By Our Military Expert

THE scene has changed once more to the western front, which has recently witnessed the most spectacular and dramatic advance of either side during the present war. This has been the British advance in the surprise attack that found the Germans off their guard between Arras and St. Quentin, and gained for the assailants great gaps in the former Hindenburg lines west of Cambrai that, when consolidated, meant a forward movement, on a front of thirty or thirty-five miles, to a maximum extent of five to seven miles. This advance has brought the British forces in some places to within three miles of the great railroad center and German supply depot of Cambrai, one of the keys to the whole German western position. The general direction of the movement was from the west toward Cambrai along the Bapaume road and from the southwest along the Peronne-Cambrai railroad.

The remarkable feature of the whole victory is that it was carried out without artillery preparation, the British troops moving forward in the wake of great land fleets of tanks that broke their way through barbed wire entanglements and lumbered across hostile trenches of any width, enfilading the latter with machine and heavy gun fire as they passed. When tanks were first employed, the general impression was that these engines of war were rather freaks than of any great value. But the work that they have done since the first day of employment is certainly one of the most striking features of the war; they have always, as in this great battle, literally driven the entering wedge in a battle, without which not much would probably have been accomplished. Their employment has also rendered possible a secret attack which would not have been the case had it been necessary to bring artillery into play to open the fight. The use of artillery always gives notice where an attack is to be expected and furnishes an opportunity to mass reserves and guns to repel it. Under these heads the tanks have fully demonstrated their power both in saving the lives of soldiers and in conserving the ammunition supply.

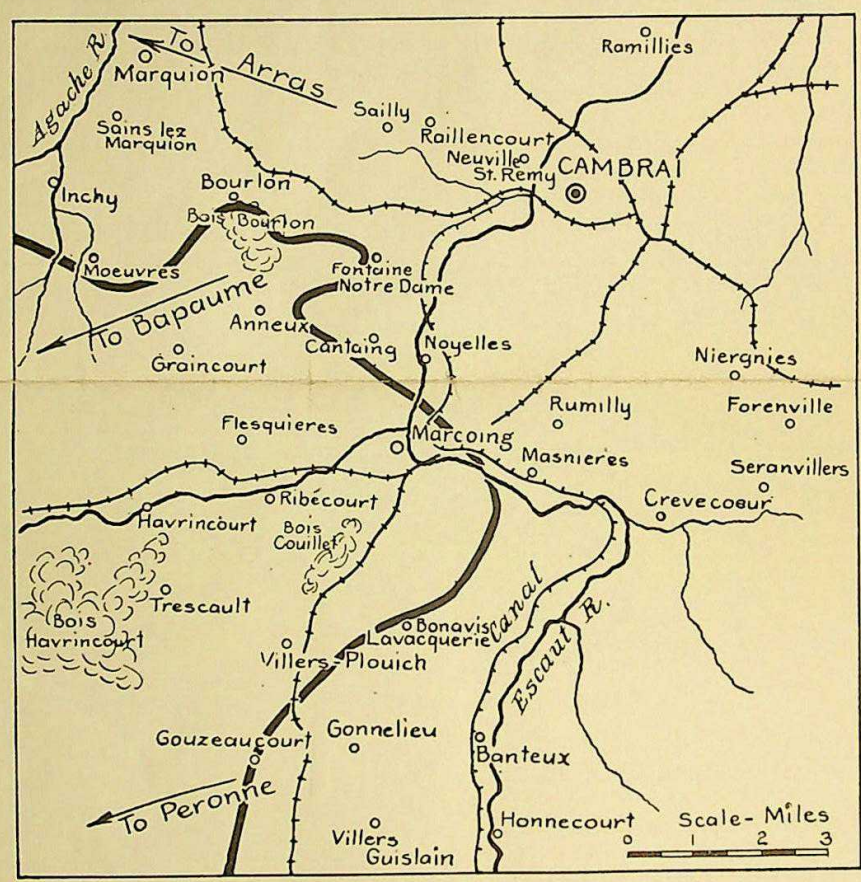
But it must not be concluded that all credit for the victory gained in the first stage of the present advance and for the progress that has been made should be given to machines; it was also due to the generalship that could conceive and execute such a surprise attack; the success of machines was only secondary. The facts are that the British commanders outgeneralled their German opponents in the movement.

It is true that attacks without adequate artillery preparation have been previously made; but they have resulted in terrible slaughter of men without adequate results. The victory at Cambrai was mainly due to the fact that it was a successful surprise attack—that is, the Germans were struck when they were not expecting it. The English commander did not find any new way to break the German lines; he simply put into operation methods centuries old. He managed a surprise concentration of men and of guns in front of a line of the enemy that was both undermanned and insufficiently supplied with guns; his plan was successful but it does not mean that this will be the case in the near future.

At the present writing the advance upon Cambrai is at a standstill for the German resistance has also stiffened due to bringing up reserves of men and guns from other parts of the front. The fighting has been particularly violent from two attacks—one of which extended from Moeuvres to Bourlon wood on the north and the other over approximately a seven-mile front southwest of Cambrai between Vendhuile and Crevecourt on the Scheldt.

Both assaults were in strong force, the infantry being supported by a large number of newly concentrated German guns. North of Cambrai the Germans were held; but on the south they broke through the British line south of Villers-Guislan where, turning to the north, they succeeding in surrounding Gauche Wood, Gouzeaucourt, Gonneliue and LaVacquerie, capturing both prisoners and guns. At the latest writing, however, the British are mentioned as holding their own and even making some gains. The struggle here has been described as one of the most desperate and bloody of the war, the German losses in the assaults having been almost unprecedented. But this counter offensive of the Germans was a most brilliant, skillful and successful one and has reduced the extent of the British gains at least one-fourth. It cannot be denied that the British were taken by surprise on the southern flank of the wedge that they had driven into the German lines; it cannot be denied also that this attack has shown the Germans are still capable of strong offensive movements on the western front. Their success here has done much to restore to their troops the morale and prestige that have been so seriously shaken recently by their reverses at other points along this front.

It may be that as a whole the success of the British here may influence the Central Allies' plans in the Italian campaign now in progress by causing a withdrawal of forces to strengthen the western front. The gain of ground, in its influence on the Entente Allies plans, can be seen by a glance at the map of the theater of war. If a start be made at St. Quentin where the British lines join the French, the present advance should soon carry forward beyond that city to the north and east, as the British have stood for months practically on the outskirts of the town. The battle line ran in a zig-zag line to the northwest, passing in a general northwesterly direction to the east of Arras. About seven miles east of the center of that line is Cambrai, one of the great objectives and now strongly threatened by the British troops. To the northeast of Arras and six or seven miles from that city lies Douai where, if the rush can be continued, the British will no doubt soon be in striking distance as a result of their present advance. In fact, the German defense of supply lines and of communications from St. Quentin north through Cambrai and Douai to Lille is in peril and its fate would be soon decided if Cambrai should be taken. The British have, in other words, shaken the German front along a quarter of the distance from Rheims to the North Sea and in the center of that front; it needs no expert knowledge to judge the effects on either flank in case of a break at the center. It may be, however, that the Germans can hold on to Cambrai until the spring opens, due to their recent strong offensive.



The Cambrai battle front on December 6th

This discussion has taken no account of the effects of a probable French advance under present conditions. Should the French move forward to threaten or take LaFère at the present time, they would also threaten Laon to the southeast. The latter has been secure behind the defences of the St. Gobain plateau; but a flank attack from the north and west would destroy the value of that citadel. An advance toward Laon would also link up with the recent gains of the French on the Aisne and Aillette Rivers southeast of Laon. It would be tightening the pressure by drawing the strings around the German defenders of St. Gobain who would either retreat or surrender. At present, it is safe only to surmise; no one can foretell the possibilities of the future. It can be stated, however, that if the Germans are driven out of Douai on the north and out of Laon on the south, they would be forced to take up a new defense line—possibly Mezières-Horsin-Maubeuge-Valenciennes-Lille. At the present writing the British hold, on the Cambrai front, Bourlon wood and the heights to the north of the Bapaume-Cambrai high road together with the villages of Anneux, Noyelles and the edge of Masnières across the Scheldt River—in general, a line from three to four and a half miles west of Cambrai.

The latest reports state that the British posted on the heights of Bourlon wood, in addition to repelling assaults, are shelling Cambrai furiously. As a German base and center of communication the town must henceforth be almost useless since the enemy is only three miles away. With the town as a target for the British artillery, either field guns or heavy guns, the system of railways centering there is practically lost to the Germans and the defensive line from Douai through Cambrai into Laon is seriously threatened. There are still some branch railroads east of Cambrai that can be used; but the main railroads under British fire can be used only at night. The Germans, however, may be able to get their vast supplies of war stores out of the city before it has to be abandoned; but, in the meantime, as any useful part of the defense line, Cambrai has ceased to be of importance. Recent reports give gains in the direction of Bourlon village despite strong opposition; it is evident the British will press the offensive to the east in order to control the base of the wedge of roads, both railroads and highways, that lead into Cambrai, now only three miles away.

It would appear that the offensive here, will be followed up by similar movements by both the British and French along many parts of the western front and that the winter season will see no halt in military operations; these will be carried out wherever possible. The pressure of the English upon the Ypres front is constant; and the combined Belgian, French and British pressure toward the Belgian coast is also increasing. It looks now as though, weather conditions permitting, a new and powerful effort will be made to force the Germans back from an extended section of the coast where the submarine bases are established. The successes around Cambrai will no doubt have an important bearing on the general plan of obtaining decisive results on the coast during the winter as foundations for more extended campaigns next year.

One part of the British lines has for some time been apparently undisturbed and out of the public eye; this is the German salient five or six miles deep around LaBassée from Armentières to Loos and Lens, a distance of 15 miles. If the British troops can make an extended drive here, it would bring their lines very close to Lille, the great German center for the front from the North Sea to Laon. A gain here would therefore be of immense strategical importance in forcing the Germans back to one of their prepared lines nearer Brussels.

While the battles around Cambrai have so profoundly affected public attention, it must not be forgotten that desperate fighting is also being carried on along the French front where a successful attack on the German lines was made in the Champagne resulting in the capture of some trenches and prisoners. North of the Chemin-des-Dames there have also been heavy artillery duels and some spirited engagements; in the Verdun sector the Germans have continued to bombard the French positions, especially around the Chaume wood to the east of the Meuse River.

In Italy the Italian armies have completed their reorganization after their disastrous retreat from the Isonzo and have withstood on the line of the Piave, but especially on the Monte Grappa and Asiago fronts to the north, the most determined assaults of the Austro-German forces. The latter have persisted for days in endeavoring to gain the summits of Monte Tomba and Monte Funera, which are foothills of the higher mountain; the latter has long been a barrier to the invasion of Italy from any part of the Trentino front. Heavy fighting has gone on here but the Austro-Germans have suffered staggering losses and have been successfully held in all the mountain regions around the headwaters of the Brenta and Piave Rivers. The 15-mile stretch between the two rivers has been the scene of bloody conflicts, but the defense of the line has been bravely and well conducted so that the Austro-German forces have been unable to make any progress. In fact, the Italian line resting on the foothills of Monte Grappa is holding firmly and the advance of the invaders appears to have been definitely checked. The morale of the Italians is improving day by day; in addition the arrival upon the northern front of both English and French reinforcements would appear to have given the necessary strength

(Concluded on page 465)

Naval and Military

Captive Balloons on Trawlers.—One more danger is added to the already large list which every U-boat must face in the war zone, the latest being the use of captive balloons on trawlers. These slow-moving boats operating off the coast of France, are now provided in some instances with a captive balloon which is sent aloft with observers. At a height of a thousand feet or more, the observers command a wide stretch of water, and on calm days can see even below the surface of the waves for a considerable distance. Submarines in this manner may be spotted and followed.

Germany Calls Her Boys of 16.—Despite constant assurances to the contrary on the part of German propagandists, there is proof sufficient that Germany is finding it difficult indeed to maintain her armies at anything like full strength. From Amsterdam comes a despatch stating that Germany is planning to force boys of 16 and 17 years into the army. In an appeal appearing in the Essen *General Anzeiger*, the boys are urged to join the Juvenile Corps. "This great struggle between the nations," says the newspaper, "will necessitate those who are now 16 and 17 being called up at no very remote date for army service."

How Our Railroads Are "Doing Their Bit."—Troop movement figures up to November 24th indicate that the railroads of this country have safely transported approximately 1,500,000 soldiers to training camps and embarkation points since August 1st, according to the *Army and Navy Journal*. Five hundred thousand of these men have made journeys necessitating overnight travel and have been moved in tourist or standard sleepers furnished by the Pullman Company. On one of the long hauls, 8,000 men were moved from a training camp on the Western coast to a point on the Eastern coast—a distance of 3,700 miles in a little less than a week.

Clothing for Men on Patrol Duty.—Only the officers and men who have had to endure the rigors of patrol work in the North Sea and the northern waters of the West Atlantic understand what a severe strain this is upon the endurance and constitution. Further, our fleet is usually sent to southern waters, with Guantanamo, Cuba, as a base, during the winter weather. Now, however, their patrol duties in European waters are subjecting them to the most severe exposure. Speaking on this subject, Thomas C. J. Peoples, of our Navy, explained before the House Appropriations Committee that the pr[illegible]cts of a winter's campaign in extremely cold [illegible]ssitates [illegible] weight of clothing from the inner garments out. The special garments now being made for these forces include: 200,000 windproof shirts, 200,000 windproof trousers, 200,000 blanket overshirts, 190,000 pairs of arctics, 200,000 pairs of mittens, 250,000 suits of underclothing, 403,500 pairs of heavy wool socks, and 10,000 pairs of high leather sea boots.

Camouflaged Roads in the War Zone.—Although numerous photographs of camouflaged roads have been published in this country, there still remains to be published a correct explanation of how the overhead screen camouflage accomplishes its purpose. Thanks to an Italian airman who has flown over camouflaged roads, we are able to tell just why a series of canvas strips stretched over a thoroughfare at certain intervals, effectively conceals the traffic. In brief, the action is simply this: When flying directly over any given point, the traffic on the road can be plainly seen if it happens to be directly underneath the airman. But when the airman tries to observe the road in either direction from a point directly below him, he merely sees the screens which, overlapping because of his angle of vision, present the appearance of a solid tunnel or tube. Obviously, the position of the road is not hidden; but all traffic is effectively concealed unless the observer happens to be directly overhead, and it is for this very reason that this form of ingenious camouflage is so often resorted to.

Latest Achievements of the Tanks.—As an effective weapon of war it seems that the tank has a brilliant future, not only when its construction will have been considerably improved upon, but especially when tank tactics are developed to a fine point as a result of considerable experience with them. French tanks played an important rôle in the last battle of the Chemin des Dames, when the Germans were swept off the Aisne heights and into the valley beyond. Tanks of the latest design, more powerful and more heavily armed than the earlier French tanks, were used to good advantage in destroying troublesome machine-gun nests and in breaking up stubborn groups of German infantry. In some instances the tanks had to fight their way uphill and cross deep ditches and shell holes. More recently, the British tanks distinguished themselves in the battle of Cambrai, at the head of General Byng's infantry which swept forward without the usual artillery preparation. We are told that the tanks maneuvered about in squad formation and were entirely successful in tearing down great stretches of the enemy's barbed wire entanglements and in smashing his concrete shelters and dispersing his machine gunners. Considerably over a hundred tanks were employed, according to reports.

Science

A Committee on Civil Aerial Transport has been appointed to consider problems relating to commercial aeronautics, aerial mail service, and the utilization of military aeroplanes and aviators after the war for non-military purposes. This step is in line with the pronounced movement in Europe for the furtherance of similar objects. Dr. W. F. Durand, chairman of the National Advisory Committee for Aeronautics, is also chairman of the new committee, and the other members are Professor Marvin, Chief of the Weather Bureau; Dr. Stratton, director of the Bureau of Standards; Lieut.-Col. V. E. Clark, Signal Corps; and Lieut-Commander J. H. Towers, of the Navy. Other members will probably be added.

Lifting the Cattle Tick Quarantine.—Since the year 1906 the joint efforts of federal and state authorities have succeeded in releasing from quarantine against the cattle tick 379,312 square miles of territory, or more than 51 per cent of the area originally quarantined. Mississippi has just celebrated with special ceremonies her release from this scourge. She is the fifth state to be declared entirely free from the tick. The area in the entire South which still remains to be released from federal quarantine is 349,250 square miles. According to the Department of Agriculture, "indications from all the tick-infested states are that in many sections the people have grown thoroughly tired of the toll the tick is taking and are patriotically building dipping-vats and making preparations to free their cattle during the coming year."

Pasteurization of Milk.—The importance of pasteurizing milk is now almost universally recognized. The practice has been advocated by the U. S. Public Health Service since 1907. In October last the quasi-national Commission on Milk Standards, appointed by the New York City Milk Committee, adopted a resolution urging the pasteurization of the milk used by American soldiers. It was recommended "that all milk, including that which enters into the preparation of milk products, especially ice cream, be pasteurized and the efficiency of the process be controlled; that such milk be reduced to a proper temperature at the source of supply and kept at that temperature during transportation and until consumed; that the specifications for the purchase of milk be in conformity with the standards recommended by this Commission."

Nitrogen Acids in Rainfall.—A committee of the British Associat[illegible] [illegible]ncement of Science has recently collecte[illegible]amples [illegible] rainfall, during a period of one year, at 16 stations scattered over the continent of Australia, and examined them quantitatively to determine their content of nitric and nitrous nitrogen. About 1,000 samples were examined, and the results were compared with the records of the weather conditions under which the rainfall occurred. The general conclusions are that, for a given type of weather, the concentration of oxidized nitrogen in the rainfall varies inversely as the amount of rainfall, and that the total amount of oxidized nitrogen per unit area found in the rainfall accompanying a storm depends upon the type of weather and is practically independent of the amount of rainfall. The highest total amounts of oxidized nitrogen were found at southern and inland stations in rain-water resulting from monsoonal storms following a heat wave.

The Demand for Textile Plant Fibers.—Mr. Lyster H. Dewey, who for some years has had charge of the fiber-plant investigations of the U. S. Department of Agriculture, set forth in a recent lecture some interesting facts regarding the present urgent need of a greater production of textile plant fibers and the steps that are being taken to supply such material. The shortage is due to the reduced production of flax and hemp in Russia and jute in India, together with difficulties of transportation and increased consumption. He stated that flax is not now regarded as absolutely necessary for tablecloths and napkins and has long since given place to cotton in most so-called linen collars and shirts, but it is needed for the wings of aeroplanes and must be largely used in shoe thread. "Ireland's 107,000 acres of flax, double the area devoted to this crop in pre-war years, and the marked increase up to 39,000 acres in Japan are helping out the supplies, while hemp and cotton are used more than ever before as substitutes." The price of hemp has increased from six cents a pound before the war to 16 cents now. In the United States the acreage devoted to hemp has grown from 4,000 to 41,000 in the past three years. Jute, normally used to a greater extent than any other fiber except cotton, is nearly all produced in India, where the crops of the past two years have been deficient. The most promising substitutes for this fiber are low-grade hemp and flax. There is a shortage of henequén (Yucatan sisal) for binder twine; the best substitute now available in this country is American-grown hemp. The scarcity of fibers has one bright side, says Mr. Dewey; it has made American spinners appreciate the possibilities of American-grown fiber as they have not done heretofore.

Electricity

Electricians Wanted in the Army.—The United States Army needs electricians and men of many other trades such as iron workers, automobile mechanics, etc., to serve in the Army along the lines of their civilian occupations in this country and abroad. Enlistment is open to citizens of the United States or to those who have declared their intention of becoming citizens. They must be between the ages of eighteen and forty-five years and have no one depending upon them for support. Men who can qualify for the above positions will be examined physically at recruiting headquarters, 357 Broadway, New York City. Military training is not required, nor are strictly military duties exacted except in emergencies.

A Non-Glaring Lighting Unit.—Will full appreciation of what glaring lighting units mean to the efficiency of workers in stores, offices, shops and factories, a manufacturer of fixtures has just introduced a device which minimizes glare. The unit is composed of two essential elements, an upper reflector of white porcelain-enameled steel, and a porcelain-enameled reflecting band which is suspended from the upper reflector in such position that it will intercept all light within the angles of 45 degrees and 85 degrees and direct it to the upper reflector for redirection to useful angles. In this manner, glare within the normal range of vision is entirely eliminated, and, it is further claimed, this elimination is accomplished with very little loss in efficiency of the unit. The outfit is practically an indirect unit, since direct light comes through only a small opening below the tip of the lamp bulb.

A Tin Pyrometer.—There has been recently introduced a tin pyrometer for measuring temperatures above the thermocouple range with the use of a direct insertion pyrometer. According to the *Electrical World*, the tin is contained in a graphite bulb and expands through a graphite capillary tube. In this way the metal is subject to a reducing atmosphere, which tends to maintain a bright surface and keep the metal pure and free from dross. The expansion of the graphite is almost negligible in comparison with that of the tin. The tin does not appreciately evaporate until a temperature of presumably 2,000 degrees C., is reached, so that no difficulty in change of calibration is encountered. A steel tube containing an insulated contact is lowered down to the capillary tube until it makes a contact with the surface of the tin and thus completes a circuit through an electric buzzer or sounder. The height of the tin is indicated by the position of the upper end of the steel tube which holds a pointer that moves beside a scale. Since the contact is insulated in quartz, which has an inappreciable thermal expansion, the inaccuracy is negligible.

A Telephone with Double Membranes.—In the *Annales des Postes, Télegraphes et Télephones*, an account is given of an interesting form of telephone receiver for which several advantages are claimed. It consists of a vessel furnished at its base with a membrane facing an electro-magnet, as in an ordinary receiver. But above this membrane is placed a hollow cone, the base of which contains a second membrane, parallel to and a few millimeters away from the first. The cone contains a second electro-magnet in series with the first one, both being traversed by the speaking current. As a result the hearing value is stated to be doubled. Moreover, the second membrane only covers about two-thirds of the first, and the annular space thus presented between the membranes and the ear has a favorable effect on the conduction of sound to the ear, tending to suppress inconvenient crackling effects and resonance. In addition, the condenser-effect of the telephone, which is generally regarded as the chief cause of resonance troubles, is considerably diminished by this new device. According to the patent the method is also applicable to microphones.

The Passing Away of William Duddell.—On Sunday, November 3d, the electrical world lost one of its ablest workers in the person of William Duddell, who passed away at the early age of 45. Born in London in 1872, Duddell was destined to become one of the leading figures in modern electrical development; and early in his career he developed his ingenious oscillograph for the study of alternating current wave forms. Some time later he conducted an exhaustive and highly interesting series of experiments on the direct-current arc, and it was during these experiments that he evolved the musical or singing arc which he found to act as a generator of high-frequency current. In recent years wireless investigators have made use of Duddell's musical arc in the development of wireless telephony and long-range wireless telegraphy, and Duddell himself turned his attention to wireless, developing remarkable instruments for detecting weak electrical currents. So thoroughly did he apply himself to the development of radio communication that he was elected president of the Commission Internationale de Télegraphie sans Fils in 1914, whose investigations were soon interrupted by the great war.